Remarks

In response to the Final Office Action dated May 24, 2004, Applicants respectfully request reconsideration. To further the prosecution of this application, each of the rejections has been carefully considered and is addressed herein. In addition, clarifying amendments have been made to two of the independent claims The application as presented is believed to be in allowable condition.

Initially, the undersigned thanks Examiners Mark Thompson and Melvin Pollack for their courtesies in granting and conducting a telephone interview on July 7, 2004. The substance of the telephone interview is summarized below.

1.　　　Overview of the Invention

One aspect of the present invention relates to the execution in multi-path computer systems of certain types of commands, referred to as "out of band control commands" (the meaning of "out of band control commands" in the context of this application was discussed extensively during the telephone interview and will be addressed further below). An example of a multi-path system is shown in Fig. 12 of the specification. In the multi-path system of Fig. 12, multiple physical paths P1-P4 are provided between a host computer 101 and a storage system. Multi-path systems can be advantageous, in that multiple communications can be processed simultaneously between the host computer and the storage system. (page 30, lines 11-12). In addition, in some multi-path systems, load balancing techniques can be employed to select appropriate physical paths for transmitting communications to increase system performance. (page 30, lines 29-31).

A specific implementation disclosed in the specification relates to the execution of a file transfer system (FTS) that performs a file transfer operation between two or more host processors 12 (Fig. 1) that each is coupled to a common data storage system 14 including a shared memory 15 that is accessible to the host processors and is used to implement the file transfer. (page 1, lines 16-19). The FTS facility employs **get** and **put** commands to perform the reading and writing of data to and from the shared storage memory 15. (page 8, lines 7-10). The **get** and **put** commands are UNIX commands implemented using lower level IOCTL commands. (page 28, lines 9-10).

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The label IOCTL refers to a set of commands in UNIX that have two characteristics that are relevant to understanding aspects of Applicants' invention.

First, IOCTL commands are implemented at a low level as port-to-port communications, such that a host computer accessing a particular device on a storage system refers to the device using a device name in a form such as "/dev/$c_x t_y d_z$," where each of x, y and z is an identifier (page 27, lines 20-23). X is an identifier uniquely identifying a controller on the host computer (e.g., a host bus adapter 115 in Fig. 12) that in turn identifies the particular port on the host computer to be used for the access; Y is an identifier uniquely identifying a target device (e.g., a storage bus director 109 in Fig. 12) which in turn identifies the particular port on the storage system 103 through which the target device is accessed; and Z is an identifier uniquely identifying the particular disk drive that is the target of the command (page 27, lines 20-29). Thus, the Syntax for an IOCTL command according to the UNIX convention specifies not only a target device for the command, but also a particular physical path (port-to-port) for use in accessing that target device (page 27, lines 29-31).

Second, IOCTL commands are executed outside of the normal read/write path of the system, and for that reason are described in the specification as being "out of band control commands." (page 28, line 11 and page 33, lines 3-6). As an example, conventional read and writes commands typically are performed based upon a modulo of a particular number of bytes (e.g., 512 bytes), such that the normal read/write path (i.e., for in band commands) includes at least one layer that implements such a restriction on any read or write operation, whereas as the **get** and **put** IOCTL commands bypass any layer implementing such a restriction, and can move exactly the number of bytes included in the subject file (page 28, lines 10-15). In addition, read and write commands that pass through the normal read/write path of the system typically are limited to a particular size (e.g., 8k), whereas the **get** and **put** IOCTL commands are not so constrained, and can move larger units of data more efficiently (page 28, lines 15-18).

In view of the fact that IOCTL commands (and other "out of band control commands") are path-specific operations, when implemented on a multi-path system such as that shown in Fig. 12, the commands will identify a particular one of the multiple physical paths P1-P4 over which the communication is to take place (page 27, lines 10-14). Conventional multi-path systems can process such commands only over the particular target path specified (page 28, lines

22-25). As a result, the benefits of employing multiple physical paths are not realized in computer systems that employ conventional techniques for the processing of IOCTL commands (or other "out of band control commands"). For example, if an IOCTL command specifies path P1 as the path over which the communication is to be transmitted, conventional systems will transfer the command over path P1, even if there is a long queue of instructions already waiting to be sent over path P1, while one of the other paths may be available for more immediate use so that the command would execute more quickly if transmitted over a different physical path.

In accordance with one embodiment of the present invention, a method and apparatus is provided that enables a physical path to be selected for transmitting IOCTL commands (or other "out of band control commands") using a selection criteria (e.g., a load balancing scheme) that enables the selected path to be other than the target path identified by the command.

While the particular implementation for which the invention was developed relates to the use of **get** and **put** commands in UNIX, the invention has applicability for other types of IOCTL commands, and also for similar commands in operating systems other than UNIX. Therefore, the claims are more broadly written to refer to out of band control commands that identify a target physical path for their transmission. In addition, in view of some prior back and forth with the Office about the proper interpretation of "out of band control command," the independent claims were previously amended to explicitly recite the definition given to "out of band control command" in the specification (see page 33, lines 3-6), by describing an out of band control command as one that bypasses at least one layer in a normal read/write path in the system.

2.   Differences Between the Claimed "Normal Read/Write Path" and the
        "Multiple Physical Paths"

As mentioned in the telephone interview agenda submitted on July 6, 2004, the prior art relied upon in the Final office action relates to networks, whereas the reference to an out of band command bypassing at least one layer in a normal read/write path in Applicants' claims refers to layers within a single device (i.e., a host computer). During the telephone discussion, the Examiners agreed that clarifying this distinction may well get to the heart of the disagreement to date between Applicants and the Office as to the relevance of the applied art.

During the telephone discussion, the Examiners pointed out that a area of potential confusion related to the distinction between the reference to the "normal read/write **path**" and the "multiple physical **paths**" recited in the claims, and whether these paths are related or distinct. The undersigned explained that the reference to physical paths in the claims relates to physical connections between the host computer and the other device, whereas the reference to the normal read/write path refers to logical or software layers within the host computer. Clarifying that point greatly facilitated the discussion during the telephone interview, as the Examiners evidenced an appreciation for the distinction that had not previously been clearly recognized from a review of the claim language.

It was discussed whether the claims could be clarified to potentially avoid the reference to two different types of "paths", with the Examiners indicating that the referenced "normal read/write path" refers to what the Examiners would consider to be a logical path such as an I/O stack. This understanding is consistent with an explanation of IOCTL commands the undersigned recently found on-line (a copy of which is enclosed), which refers to an IOCTL call as one that varies according to the particular device driver employed, as "the call is used as a catch-all for operations that don't cleanly fit the Unix stream I/O model."

During the telephone interview, the undersigned agreed to look at the specification to determine whether there might be alternate language that could be employed to avoid the use of the term "path", while sticking to the language employed in the specification. In this respect, the Examiner agreed that care should be taken to not stray from the language employed in the specification, and that if necessary, summarizing the distinction here and in the Examiners' interview summary would be sufficient to clarify the issue on the record.

After reviewing the specification, no amendments have been made to the reference to either the normal read/write path or the physical path, as that is the terminology used in the specification. However, a clarifying amendment has been made to independent claims 1 and 8, such that the normal read/write path is referred to as being in the host computer, as opposed to being recited more broadly as being in the system. In this manner, claims 1 and 8 have been amended to be consistent with claim 15. It is believed that one of skill in the art reading the specification would clearly understand that the normal read/write path referred to in the specification is a logical path within the host computer, such that no new matter is added. For

example, the explanation provided in the specification of **get** and **put** commands being different

from normal reads and writes because they are not constrained to operate on a modulo of a

particular number of bytes (page 28, lines 10-15) provides an example of the types of "one or

more layers in the normal read/write data path" (page 32, line 25) that is provided in the host

computer and may be bypassed by an out of band command.

3.   The Rejections Under 35 U.S.C. §103

Each of the independent claims has been rejected under 35 U.S.C. §103 as being obvious

over Weston-Dawkes in view of Eslambolchi and Grun. This rejection is respectfully traversed.

a.   Weston-Dawkes

Weston-Dawkes is directed to a technique for enhancing communication in a network.

Weston-Dawkes teaches that a network typically includes a set of physical interconnections

between devices in the network (Fig. 1) and one or more layers that organize the computers in a

logical fashion (such as the rings shown in Fig. 2) to simplify the complexity of the network.

(col. 1, lines 58-60 and col. 2, line 12-col. 3, line 62).

Weston-Dawkes is directed to improving efficiency for the transmission of data units

over a virtual circuit, which is a circuit in which all data units from a source to a sink are

transmitted through exactly the same network nodes and routers so that sequencing is

maintained. (col. 3, lines 63-65). It is asserted that the implementation of virtual circuits using

the higher level logical layers can result in less than optimal efficiency in the actual physical

paths over which data units are transmitted through a virtual circuit. (col. 8, lines 40-53). Thus,

Weston-Dawkes implements virtual circuits by bypassing the logical layers and establishing

virtual circuits using direct physical connections, under the control of a lattice control 408 (Fig.

4). (Col. 9, lines 25-47).

b.   Eslambolchi

Eslambolchi is directed to a technique for re-establishing virtual circuits in a frame relay

network in an efficient manner following a service outage. (col. 1, lines 7-10). This is done by

contacting the switches in the network using communications that are out of band with respect to

the frame relay network itself, such as by using a dedicated control network or dial ups. (col. 1,

lines 63-65).

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    c.   The Combination of Weston-Dawkes, Eslambolchi and Grun
            <u>Would, At Most, Relate to Techniques for Implementing A Network Environment</u>

To the extent the references relied upon are combinable (which Applicants do not concede), at most, one of skill in the art may have been motivated to employ the techniques taught by Eslambolchi to reestablish the virtual circuits set up in Weston-Dawkes by using a control network that is out of band with respect to the communications network itself. As should be appreciated from the discussion above, such a system is entirely unrelated to the nature of the present invention, as the teachings of Eslambolchi and Weston-Dawkes (and Grun also) simply are not relevant to the type of out of band command recited in Applicants' claims, i.e., an out of band command that bypasses at least one layer in a normal read/write path in a host computer and identifies a target physical path for its transmission.

In view of the foregoing, it is respectfully asserted that the prior art of record is not relevant to the claimed invention.

    d.   <u>Claims 1-7</u>

As should be appreciated from the foregoing, the prior art of record does not teach or suggest a method of processing an out of band command that identifies a target physical path for its transmission and that is a command of the type that bypasses at least one layer in a normal read/write path in a host computer. Therefore, the prior art of record necessarily fails to teach or suggest a method of selecting a physical path for transmitting such an out of band control command based upon a selection criteria that enables the selected physical path to be other than the target physical path identified by the out of band control command.

In view of the foregoing, it is respectfully asserted that claims 1-7 patentably distinguish over the prior art of record, such that the rejection of these claims under 35 U.S.C. §103 should be withdrawn.

    e.   <u>Claims 8-14</u>

Claim 8 recites a computer readable medium encoded with a program that, when executed, performs a method substantially similar to claim 1. Thus, for the reasons discussed above, it is respectfully asserted that claims 8-14 patentably distinguish over the prior art of record, such that the rejection of these claims under 35 U.S.C. §103 should be withdrawn.

f.   Claims 15-22

Claim 15 is directed to a host computer that comprises at least one processor to execute an out of band control command that bypasses at least one layer in a normal read/write path in the host computer and that identifies a target physical path for its transmission, as well as at least one controller that selects a physical path for transmission of the out of band command based upon a selection criteria that enables the selected physical path to be other than the target physical path identified by the out of band control command.

As should be appreciated from the foregoing, the prior art of record fails to teach or suggest the processing of the type of out of band control command recited in claim 15, and therefore necessarily fails to teach a host computer including at least one controller that can select a physical path for transmitting such a command based upon a selection criteria that enables the selected path to be other than the physical path specified by the command.

In view of the foregoing, it is respectfully asserted that claims 15-22 patentably distinguish over the prior art of record, such that the rejections of these claims under 35 U.S.C. §103 should be withdrawn.
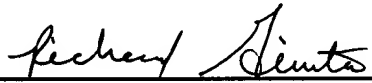
CONCLUSION

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, he is requested to call the Applicants' attorney at the number listed below.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 23/2825.

Respectfully submitted,
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